

Claims

1. A factor X analog which contains a modification between Glu226 and Ile235, relative to the amino acid numbering according to Figure 1.

2. The factor X analog of claim 1 wherein the modification is between  
5 Glu226 and Arg 234.

3. The factor X analog as claimed in Claim 1, characterized in that it contains a factor X sequence with Glu226-R8-R7-R6-R5-R4-R3-R2-Arg234-R1, wherein

- a) R1 is an amino acid selected from the group Ile, Val, or Ala,
- 10 b) R2 is an amino acid selected from the group Thr, Ser, or Asn,
- c) R3 is an amino acid selected from the group Phe, Leu, Arg, or Ile,
- d) R4 is an amino acid selected from the group Asp, Lys, Thr, or Glu,
- e) R5 is an amino acid selected from the group Asn, Ser, Lys, Met, Thr, or Asp;
- f) R6 is an amino acid selected from the group Phe, Thr, Ser, Pro, Leu, or Ile,
- 15 g) R7 is an amino acid selected from the group Ser, Gln, Ile, Thr, Asn, or Pro, and
- h) R8 is an amino acid selected from the group Gln, Ser, His, Tyr, or Glu.

4. The factor X analog of claim 1, characterized in that it contains a modification in the region of amino acids 227-233 of the factor X sequence, relative to the amino acid numbering according to Figure 1, as follows:

20 Gln227-Ser228-Phe229-Asn230-Asp231-Phe232-Thr233

5. The factor X analog of claim 4 wherein amino acid 235 is also modified.

6. The factor X analog of claim 1, characterized in that it contains a modification in the region of amino acids 227-233 of the factor X sequence, relative to the amino acid numbering according to Figure 1, as follows:

25 Ser227-Gln228-Thr229-Ser230-Lys231-Leu232-Thr233.

7. The factor X analog of claim 6 wherein amino acid 235 is also modified.

8. The factor X analog of claim 1 wherein the modification forms a processing site for factor XIa or a derivative thereof.

9. The factor X analog of claim 1 characterized in that it has an additional  
30 modification in the region of the C-terminal factor X amino acid sequence.

10. The factor X analog as claimed in Claim 9, characterized in that it has a modification in the C-terminal region of the  $\beta$ -peptide cleavage site.

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11. The factor X analog of claim 1 wherein said modification permits an *in vivo* activation of the factor X analog into native factor Xa or a factor Xa analog.

12. The factor X analog of claim 1 wherein said modification permits an *in vitro* activation of factor X analog into native factor Xa or a factor Xa analog.

5 13. The factor X analog of claim 1 wherein said analog contains an intact  $\beta$ -peptide.

14. The factor X analog of claim 1 in the form of a double-chain molecule.

15. The factor X analog of claim 1 having a shortened C-terminal region.

10  $\rightarrow$  16. A recombinant DNA coding for the factor X analog of claim 1 contained in a vector for the recombinant expression of the coded protein.

17. A preparation containing a purified factor X analog or a precursor protein thereof, said factor X analog containing a modification between Glu226 and Ile235, relative to the amino acid numbering according to Figure 1.

15 18. The preparation of claim 17 wherein the modification is between Glu226 and Arg 234.

19. The preparation as claimed in Claim 17, characterized in that the modification forms a cleavage site for factor XIa or a derivative thereof.

20. The preparation of claim 17, characterized in that the factor X analog is present in the form of FX $\alpha$ .

20 21. The preparation of claim 17 wherein the factor X analog has a shortened C-terminal amino acid sequence.

22. The preparation of claim 17, characterized in that it contains factor X analog as a double-chain molecule.

25 23. The preparation of claim 17, characterized in that it contains a single-chain factor X analog in enzymatically inactive form, with a purity of a minimum of 80% and that it does not contain inactive proteolytic intermediates of factor X/Xa analog.

24. The preparation of claim 17, characterized in that it contains factor X analog as a single-chain molecule.

30 25. The preparation of claim 17, characterized in that it contains a factor X analog which has a modification that permits an *in vivo* activation of the factor X analog into native factor Xa or into a factor Xa analog.

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27. The preparation of claim 17, characterized in that it is formulated as a  
5 pharmaceutical preparation.

29. The preparation of claim 28, characterized in that it contains a physiologically acceptable matrix and is present in a form that is stable to storage.

15            31. The preparation of claim 30, characterized in that it contains a minimum of one component with factor VIII inhibitory bypass activity as an additional component.

20 33. The use of the preparation of claim 17 to produce a drug.

35. A method for the production of the preparation of claim 17,

36. A method for the production of preparation of a factor X analog, said method comprising the following steps:

- preparation of a recombinant DNA coding for the factor X analog of claim 1 contained in a vector for the recombinant expression of the coded protein
- 30 - transformation of a suitable cell
  - expression of the factor X analog
  - isolation of the factor X analog, and

- purification of the factor X analog by means of a chromatographic process.

37. The method as claimed in claim 36, characterized in that after expression of the factor X analog it is activated by factor XIa or a derivative thereof.

38. The method as claimed in claim 35, characterized in that the factor X  
5 analog is isolated in the form of a double-chain molecule.

39. The method of claim 35, characterized in that the double-chain factor X analog is cleaved with factor XIa or a derivative thereof.

40. The method of claim 35, characterized in that the factor X analog is isolated in the form of a single-chain molecule.

10 41. The method as claimed in Claim 39, characterized in that a single-chain, factor X analog is processed with furin or a derivative thereof and that further allows the activation with factor XIa or a derivative thereof into factor Xa or the factor Xa analog.

42. A method for the production of a preparation containing activated factor  
15 Xa or a factor Xa analog, characterized by the fact that a factor X analog which was produced using the method of claim 35 is subjected to an activation step.

43. A method as claimed in Claim 35, characterized by the fact that a purified factor Xa analog or a native factor Xa with a high stability and structural integrity which is free from inactive factor X/Xa intermediates is obtained.  
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